(19) DANMARK

(10) DK/EP 2138716 T4

Patent- og Varemærkestyrelsen

(12) Oversættelse af ændret europæisk patentskrift

(51) Int.Cl.: *F 03 D 1/06 (2006.01)* *B 29 C 70/44 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2024-03-11**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om opretholdelse af patentet i ændret form: **2024-02-14**

(86) Europæisk ansøgning nr.: **09008602.6**

(86) Europæisk indleveringsdag: **2009-06-25**

(87) Den europæiske ansøgnings publiceringsdag: **2009-12-30**

(30) Prioritet: **2008-06-27 ES 200801927** **2008-11-18 ES 200803279**

(84) Designerede stater: **AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR**

(73) Patenthaver: **SIEMENS GAMESA RENEWABLE ENERGY INNOVATION & TECHNOLOGY, S.L., Avenida de la Innovación 9-11, 31621 Sarriguren (Navarra), Spanien**

(72) Opfinder: **Sanz Pascual, Eneko, c/o GAMESA INNOVATION & TECHNOLOGY S.L., Avenida Ciudad de la Innovación 9-11, 31621 Sarriguren, Spanien**
Arocena De la Rua, Ion, c/o GAMESA INNOVATION & TECHNOLOGY S.L., Avenida Ciudad de la Innovación 9-11, 31621 Sarriguren, Spanien
Arroz Collado, Sandra, c/o GAMESA INNOVATION & TECHNOLOGY S.L., Avenida Ciudad de la Innovación 9-11, 31621 Sarriguren, Spanien

(74) Fuldmægtig i Danmark: **Zacco Denmark A/S, Arne Jacobsens Allé 15, 2300 København S, Danmark**

(54) Benævnelse: **Vingeindsats**

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DESCRIPTION

Object of the invention

[0001] The invention describes an insert for a wind turbine blade according to the preamble in the first claim.

Background of the invention

[0002] Wind turbines blades are typically joined to the wind turbine hub with a mechanical multipoint joints, prestressed with stressed screws. Likewise, the blades divided into several modules can be assembled with mechanical joints between metal parts called inserts. The basic function of these blade root joint elements and the intermediate joint elements is transferring traction and/or compression loads transmitted from the blade laminations.

[0003] The nearest state-of-the-art corresponds to patent EP 18789155 where metal inserts axially housed in blade module walls are presented, where this wall is made of a composite lamination with a series of holes. The structural joint between the composite material and the inserts is carried out with chemical means (adhesive) and is defined as a single shear joint, as each side of the insert is in contact with one of the sides of the hole in the composite material.

[0004] However, the transfer of traction and/or compression loads produced in the blade's laminations as a consequence of the loads caused in the blade by the action of the wind are very big. This problem could be solved reinforcing the module walls with more fibre and large inserts, but this excess weight in the blades would unacceptably increase loads in the wind turbine.

Description of the invention

[0005] To obtain a suitable loads transfer, a specific insert is defined which is installed in such a way in the blade lamination that it forms a double shear joint.

[0006] The insert is made up of two defined parts, the head and the body, and the head is designed for screwing the insert to another structure (for example, the wind turbine hub bearing or another insert corresponding to another blade module), while the body comprises a cylindrical or conical area with a conical inner cavity for chemically joining the insert to the lamination. The example with the insert screwed to the hub bearing is outside the scope of the invention.

[0007] The joint between the insert and the lamination has two alternatives:

- in the first, the insert is joined to the lamination with chemical means (adhesive), inside a machined cavity in the already cured lamination.
- in the second, the insert is embedded in the lamination, together with an inner part, during the laminating process. During the lamination curing process, the composite material resin chemically bonds the lamination to the insert.

[0008] On its part, the head of the insert has two alternatives according to the insert we are talking about, an insert for joining intermediate blade parts or a blade root insert;

- in the first alternative, the insert determines an metal fitting head with a through hole
- in the second alternative, the head of the insert is completely laminated and determines an inner threaded area.

The blade root insert is outside the scope of the invention.

Brief description of the figures

[0009] The following figures are included to explain the insert's joint:

Figure 1 shows a section of the insert joint and the blade wall lamination according to a first embodiment.

Figure 2 constitutes a transversal section of the joint between the insert and lamination corresponding to the previous figure.

Figure 3 shows a section of the insert joint and the blade wall lamination according to a second embodiment.

Figure 4 constitutes a transversal section of the joint between the insert and lamination corresponding to the previous figure.

Figures 5 and 6 show a section of the joint indicating the transmission of loads according to the rigidity of the material used in the inner part.

Figures 7 and 8 show two examples of the insert head, according to its area of implementation in the blade. The example of figure 7, relating to a blade root, is outside the scope of the invention.

Figure 9 shows the joint between the two inserts of different structures according to the embodiment in figure 7.

Figure 10 shows a section of the insert of the joint between the metal fitting, the insert and the bolt according to the embodiment in figure 7.

Figure 11 shows an embodiment of a tightening tool related to the embodiment of figure 7.

Description of a preferred embodiment

[0010] The present invention is related to the blades whose main laminations (located in the central areas of the top and bottom of the aerodynamic profile) are manufactured out of solid lamination and it describes a blade insert whose characteristics allow for implementing it on the blade with a double shear joint.

[0011] As shown in figure 1, the blade insert subject to the present invention, comprises two different parts, head (2) and body (3), with the head (2) designed for screwing, with fixing elements (9), the insert to another structure (1', 2', 3'), and the body (3) designed for fixing to the lamination (1) of the blade with adhesive means (4).

[0012] The insert's body (3) determines a cylindrical or conical shape with an inner conical cavity, while the head, as shown in figures 7 and 8, determines a threaded area or an area with an iron head with a through hole according to if it is installed as an insert on the blade root (which is outside the scope of the invention) or as a blade intermediate joint insert, respectively.

[0013] In this way, in a first embodiment, the joint between the insert body (3) and the blade lamination (1) is carried out by thickening the lamination (1) near to the joint, so that when the lamination has cured, it can be machined with revolution geometry, determining a conical cavity that coincides with the shape of the insert's body (2), and this body (2) inserted with adhesive means (4), see figures 1 and 2.

[0014] In another embodiment of the joint, the insert is embedded in the blade lamination, and therefore an inner part (5) stuck to the insert body (3) is inserted, as shown in figure 3, that allows for continuously laminating composite material layers from the blade lamination to the top of the insert.

[0015] This inner part (5) determines two sections, one conical (5.1), stuck with adhesive (4) to the surface of the insert body's conical inner cavity (3), and another cylindrical cavity (5.2) and chamfered.

[0016] These inner parts (5) can be made of different materials according to the resistance of the joints required for each application. In this way, when there are high resistance requirements a rigid material such as fiberglass is used, for example, and when these requirements are low a light and less rigid material is used such as foam or wood.

[0017] Loads transmission (8) is different in each case, as shown in figures 5 and 6, as when

rigid materials are used in the inner part (5), a part of the load is transmitted from the insert directly to the lamination (1) and another part of the load is transmitted from the insert to the inner part (5) to subsequently pass onto the lamination (1) via the inner part's (5) surface, which is outside the insert, making up in this way a double shear joint, while in the case of using lighter and less rigid materials, loads transmission (8) between the insert and the lamination (1) is mainly carried out via the outer side of the insert.

[0018] Finally, the introduction of some separators (6) between inserts is foreseen, which may be made out of fiberglass or foam.

[0019] The method for positioning the insert next to the inner part (5) is characterized by using a mould (7) with a corrugated surface so that the lamination (1) adapts to the insert's cylindrical shape. A series of layers of composite material are laminated on this surface (fiberglass or carbon fiber) and on them are placed the inserts to which the inner parts (5) have been stuck beforehand. The separators (6) described above are positioned between the inserts, and finally the rest of the composite material layers are laminated on the inserts.

[0020] The lamination process may out of preimpregnated material, i.e., the material has been previously impregnated in resin, or dry fabric followed by a resin infusion.

[0021] As it has been said before, according to the characteristics of the joint to be made (if it is going to be installed as an insert of the blade root or as an insert to join intermediate parts) the head (2) of this insert varies, as if the insert is going to be joined to a flange (blade root joint), this head (2) determines an inner threaded area and is embedded in the lamination (1) of the blade and if the insert is going to be joined to an identical insert on another structure, it determines a metal fitting head (2) equipped with a through hole that is not embedded in the lamination (1) (see figures 7 and 8 respectively).

[0022] As shown in Figure 9, another alternative to join the insert to an identical insert of another structure (1', 2', 3'), foresees inserting an auxiliary metal fitting (10) that determines at least one non-threaded through hole (11) and that houses the fastening head (12) of the anchor bolts (9, 9') of both inserts of the structures (1, 2, 3; 1', 2', 3').

[0023] These bolts (9, 9') determine an inner "anti-clockwise" thread (13), an outer "clockwise" thread (14) and a fastening head (12) at the end of the bolt (9, 9'). After the fastening head (12) is a nut (15) that determines on this bolt (9) a "clockwise" thread, as shown in Figure 10. Between the nut (15) and the auxiliary metal fitting (10) is a washer (20).

[0024] The tightening process is based on exerting a torque on the outer surface of the nut (15) that is reacted on the fastening head (12) of the bolt (9). When the torque is applied, if the two threads (13, 14) of the bolt (9) are correctly lubricated, no relative movement will occur between the head (2), the auxiliary metal fitting (10) and the nut (15). As a result of the applied torque, the bolt (9) progresses in one direction along the head's thread (2) and in the opposite direction on the nut's (15) thread, which results in a prestressing of the bolt (9).

[0025] To make the tightening according to this preferred embodiment, a tool like the one shown in Figure 11 is used. This tool preferably consists of two different parts: a fixed wrench (16) that supports the nut (15) during tightening and an active wrench (17) consisting of a fixed track (18), that is integrally joined to the fixed wrench (16), and a moving track (ratchet type) (19), that applies the torque to the fastening head (12) of the bolt (9).

REFERENCES CITED IN THE DESCRIPTION

Cited references

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Patent documents cited in the description

- EP18789155A **[0003]**

Patentkrav

1. Vindmøllevinge, omfattende en vingeindsats, der er koblet i den faste laminering, som er anbragt i den øvre eller nedre midterdel af den aerodynamiske del af en vinge af en vindmølle, **kendetegnet ved** at være fremstillet af et hoved (2) til at skrue vingeindsatsen i en anden struktur (1', 2', 3'), og et legeme (3), som bestemmer en cylindrisk eller konisk form med et indvendigt konisk hulrum til at samle den udvendige og indvendige flade af vingeindsatsens legeme (3) til lamineringen (1) af vingen ved hjælp af en klæbende, kemisk, dobbelt indkapslet samling (4).

2. Vindmøllevinge omfattende en vingeindsats, ifølge det første krav, kendetegnet ved, at den omfatter mindst én indvendig del (5), som hæfter til den indvendige del af indsatsens legeme (3), der er indlejret i lamineringen af vingen (1).

3. Vindmøllevinge omfattende en vingeindsats ifølge et andet krav, kendetegnet ved, at den indvendige del (5), når der er høje modstandskrav, er fremstillet i et stift materiale som fiberglas.

4. Vindmøllevinge omfattende en vingeindsats ifølge et andet krav, kendetegnet ved, at den indvendige del (5), når der er lave modstandskrav, er fremstillet i et let og ikke særlig stift materiale som skum eller træ.

5. Fremgangsmåde til placering af en vingeindsats indvendigt i en vingelaminering (1) ved fremstilling af en vindmøllevinge ifølge et hvilket som helst af kravene 2-4, omfattende de følgende trin:

- anvendelse af en form (7) med en korrugeret flade, således at lamineringen (1) tilpasses et cylindrisk formet legeme (3) af en indsats
- laminering af en række kompositte materialelag på denne flade (fiberglas eller carbonfiber)

- placering på lamineringen (1) af de indsatser, som de indvendige dele (5) tidligere har hæftet til
- placering af separatorer (6) mellem indsatserne
- resten af de kompositte lag lamineres på indsatserne og separatorerne (6)

6. Fremgangsmåde til placering af en vingeindsats indvendigt i en vingelaminering ifølge krav 5, hvor separatorerne fremstilles af fiberglas eller skum.

7. Fremgangsmåde til placering af en vingeindsats indvendigt i en vingelaminering ifølge krav 5, kendetegnet ved, at der anvendes en forimprægneringslamineringsproces, for at forimprægnere materialet med harpiks.

8. Fremgangsmåde til placering af en vingeindsats indvendigt i en vingelaminering ifølge krav 5, kendetegnet ved, at der anvendes en tørvævslamineringsproces, efterfulgt af en infusion med harpiks.

9. Vindmølle, omfattende en vingeindsats, ifølge det første krav, kendetegnet ved, at den omfatter en ekstra metalfitting (10) til at skrue vingeindsatsen til en anden struktur (1', 2', 3'), som bestemmer mindst ét gennemgående hul (11) uden gevind og mindst én ankerbolt (9, 9') for hver struktur, der skal forbindes.

10. Vindmølle ifølge krav 9, hvor ankerbolten (9) bestemmer et indvendigt gevind (13) modsat urets retning, et udvendigt gevind (14) i urets retning og et fastgørelseshoved (12) på enden af bolten (9), omkring hvilket der er skruet en møtrik (15).

11. Vindmølle ifølge krav 9, hvor møtrikken (15), der skal skrues på bolten (9) af vingeindsatsen, har et gevind i urets retning.

DRAWINGS

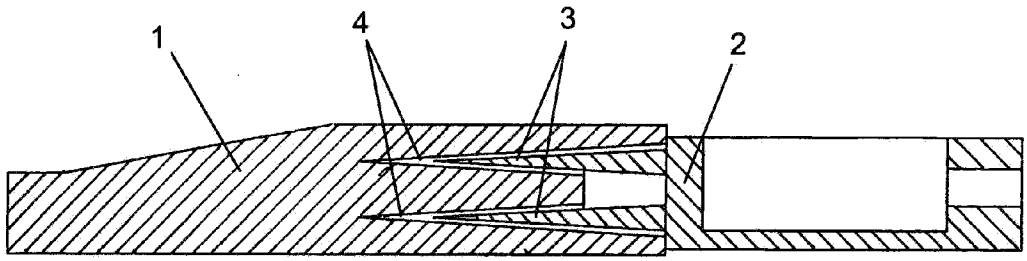

Fig. 1

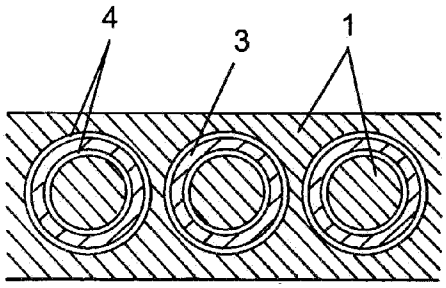

Fig. 2

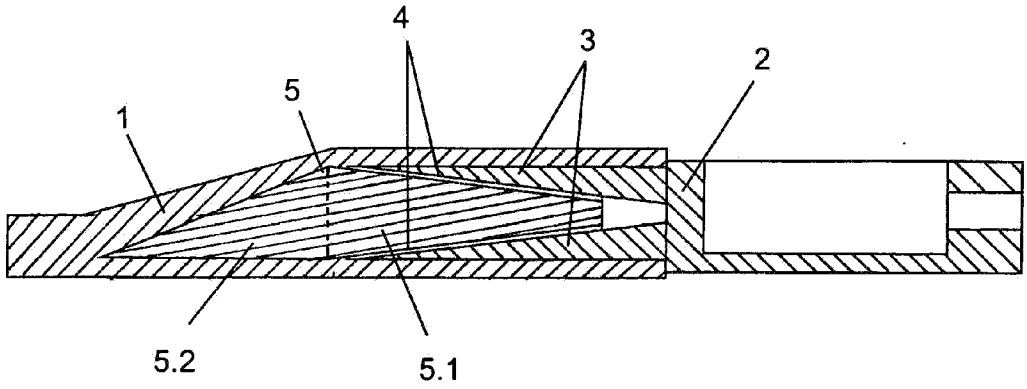

Fig. 3

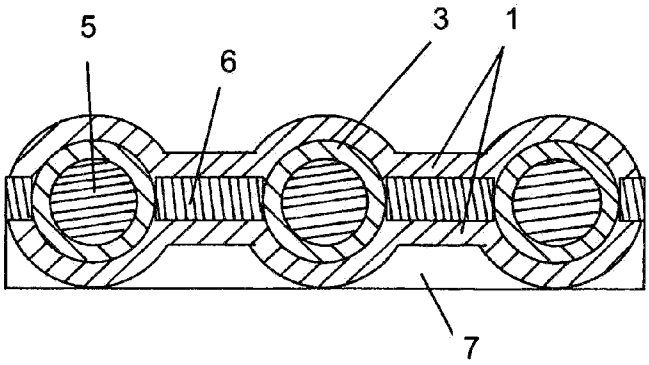

Fig. 4

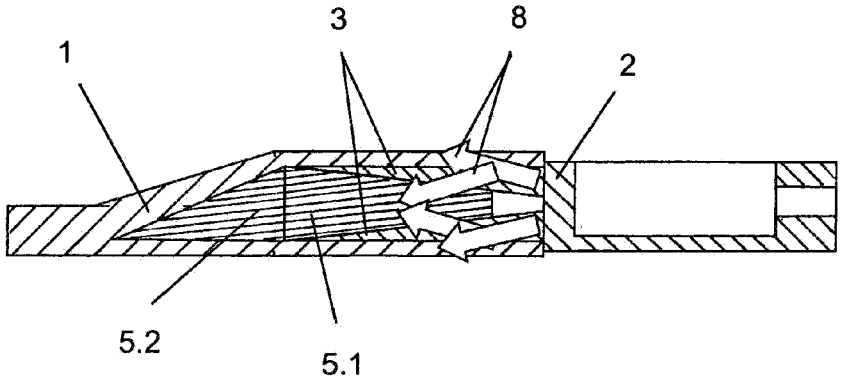

Fig. 5

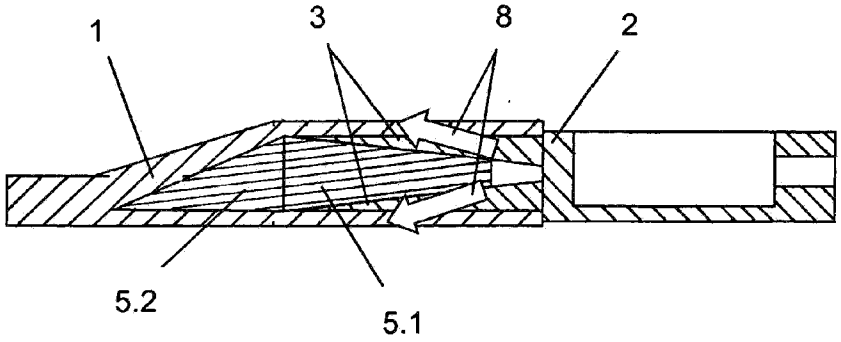

Fig. 6

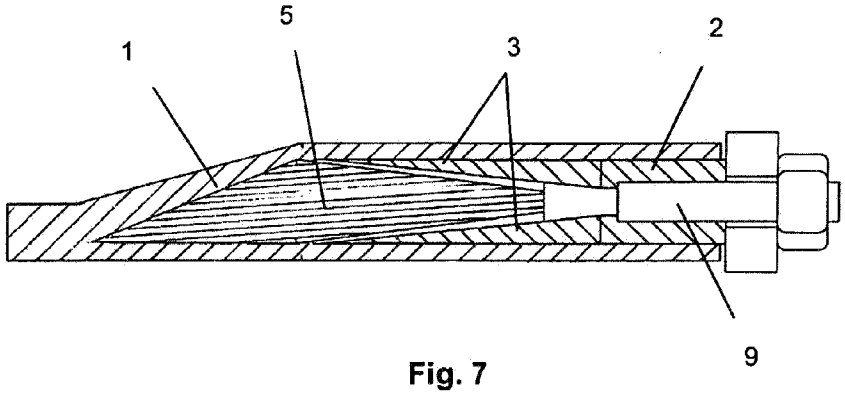

Fig. 7

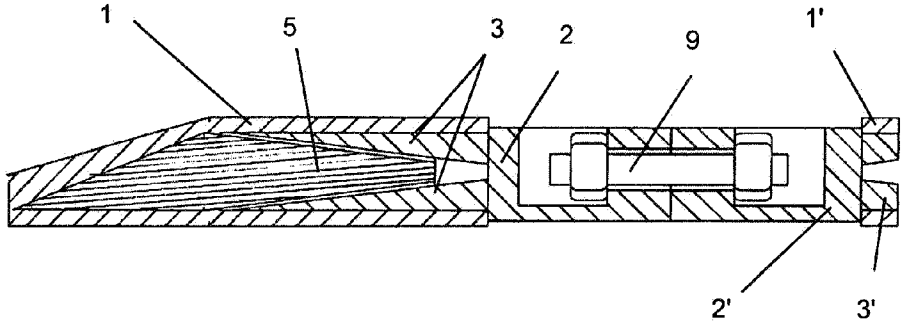

Fig. 8

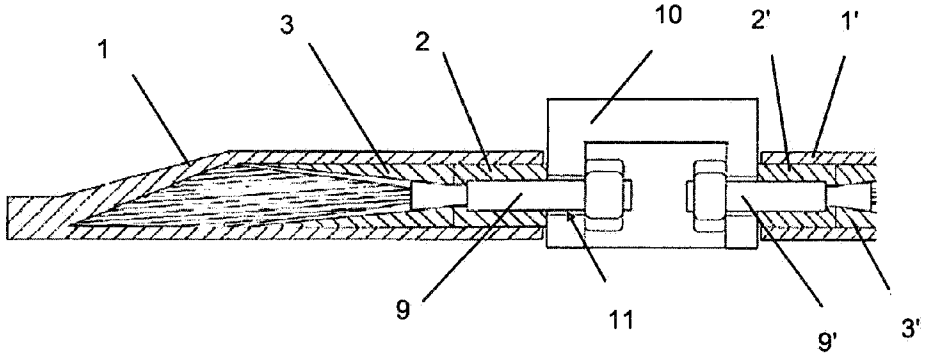

Fig. 9

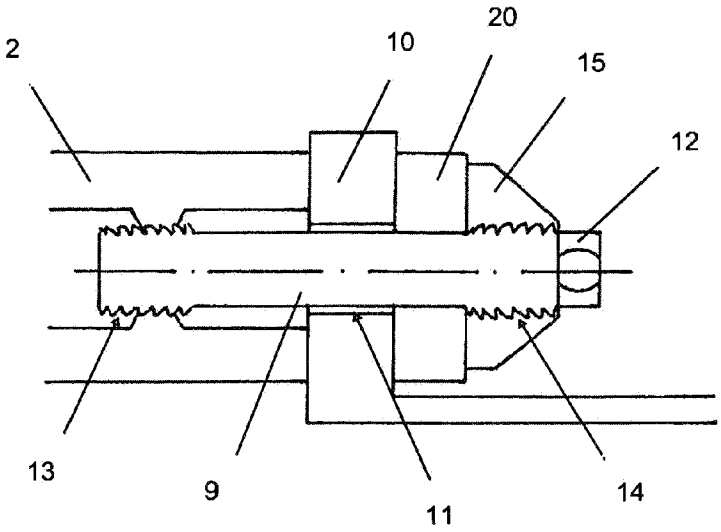

Fig. 10

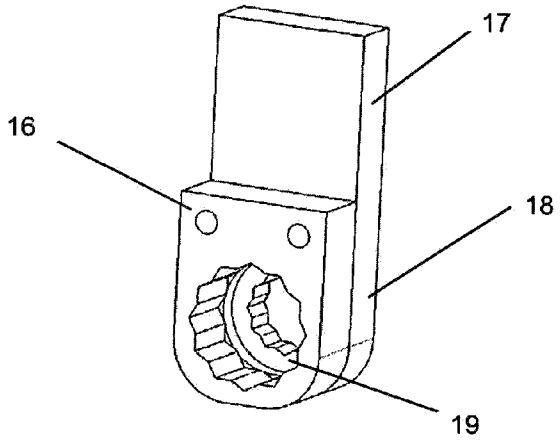

Fig. 11